

REMARKS

This is intended as a full and complete response to the Office Action dated October 7, 2004, having a shortened statutory period for response set to expire on January 7, 2005. Please reconsider the claims pending in the application for reasons discussed below.

Claims 1-14 remain pending in the application and are shown above. Claims 1-14 are rejected by the Examiner. Reconsideration of the rejected claims is requested for reasons presented below.

Applicants note that the PAIR system shows that the Information Disclosure Statements filed by Applicants on June 9, 2004, and September 15, 2004, have been received by the Patent Office. Applicants respectfully request consideration of the references cited in the Information Disclosure Statements filed by Applicants on June 9, 2004, and September 15, 2004.

Claim 8 is amended to correct matters of form. Claim 10 is amended to more clearly recite the claimed subject matter. These amendments are not presented to distinguish a reference, thus, the claims as amended are entitled to a full range of equivalents if not previously amended to distinguish a reference.

Applicants have added new claims 15-33. Applicants submit that the changes made herein do not introduce new matter.

Claims 1, 2, and 4 stand rejected under 35 U.S.C. § 102(e) as being anticipated by *Kang, et al.* (U.S. Patent No. 6,139,700). The Examiner states that *Kang, et al.* teaches a method comprising forming a refractory metal nucleation layer, WN, by serially exposing said substrate to first and second reactive gases (claim 16), and forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said first and second reactive gases (column 6, lines 13+). Applicants respectfully traverse the rejection.

Kang, et al. describes a process comprising forming a metal barrier layer by atomic layer deposition (claim 1). However, Applicants submit that *Kang, et al.* does not describe a process comprising forming a bulk deposition layer on the metal barrier layer by employing vapor deposition to bulk deposit a refractory metal contained in one of

said first and second reactive gases used to deposit the refractory metal nucleation layer. Column 6, lines 13-16 of *Kang, et al.* state that the cluster tool in which the process of *Kang, et al.* may be performed can further include a conventional aluminum CVD chamber for forming a subsequent metal line, a tungsten CVD chamber, and a degassing chamber. Applicants submit that *Kang, et al.*'s description of a tungsten CVD chamber on the cluster tool does not provide a teaching or suggestion of forming a bulk deposition layer on the metal barrier layer. Applicants further submit that *Kang, et al.*'s comparison of the properties of ALD barrier layers and CVD barrier layers (column 6, lines 17-65) does not teach or suggest forming a bulk deposition layer on a nucleation layer by employing vapor deposition.

Thus, *Kang, et al.* does not teach, show, or suggest a method for forming a nucleation layer and a bulk deposition layer on a substrate disposed in a processing chamber, said method comprising forming a refractory metal nucleation layer by serially exposing said substrate to first and second reactive gases, and forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said first and second reactive gases, as recited in claim 1. Applicants respectfully request withdrawal of the rejection of claim 1 and of claims 2 and 4, which depend thereon.

Claims 10-13 stand rejected under 35 U.S.C. § 102(e) as being anticipated by *Kang, et al.* (U.S. Patent No. 6,139,700). The Examiner states that *Kang, et al.* teaches a method comprising serially exposing a substrate to first and second reactive gases, wherein said second reactive gas comprises a refractory metal selected from the group consisting of titanium (Ti) and tungsten (W), while said substrate is disposed in a processing chamber, to form a nucleation layer (claim 16), removing from said processing chamber said first reactive gas before exposing said substrate to said second reactive gas (column 5, lines 38+), and forming said layer adjacent to said nucleation layer by chemical vapor deposition while said substrate is disposed in said processing chamber by concurrently exposing said nucleation layer to said second reactive gas and a reducing agent (column 4, lines 17+). Applicants respectfully traverse the rejection.

Column 4, lines 9-18 of *Kang, et al.* describe depositing a Ti barrier layer 16 on a substrate from a gas mixture comprising TiCl_4 , argon, H_2 , SiH_4 , and Si_2H_6 . Applicants respectfully submit that Ti barrier layer 16 is not a bulk deposition layer that is formed by concurrently exposing a nucleation layer to a reactive gas and a reducing agent, wherein nucleation layer is formed by serially exposing a substrate to first and second reactive gases. As shown and described in *Kang, et al.*, Ti barrier layer 16 is formed on an interlaying insulating film 12 rather than on a nucleation layer (column 4, lines 9-11, Figure 1A). Applicants further submit that *Kang, et al.* does not teach or suggest forming a bulk deposition layer adjacent to a nucleation layer by concurrently exposing said nucleation layer to a reducing agent and a reactive gas used to deposit the nucleation layer or forming a bulk deposition layer adjacent a nucleation layer in the same chamber used to deposit the nucleation layer.

Thus, *Kang, et al.* does not teach, show, or suggest a method for forming a nucleation layer and a bulk deposition layer on a substrate, said method comprising serially exposing said substrate to first and second reactive gases, wherein said second reactive gas comprises a refractory metal selected from the group consisting of titanium (Ti) and tungsten (W), while said substrate is disposed in a processing chamber, to form a nucleation layer, removing from said processing chamber said first reactive gas before exposing said substrate to said second reactive gas, forming a bulk deposition layer adjacent to said nucleation layer by chemical vapor deposition while said substrate is disposed in said processing chamber by concurrently exposing said nucleation layer to said second reactive gas and a reducing agent, as recited in claim 10. Applicants respectfully request withdrawal of the rejection of claim 10 and of claims 11-13, which depend thereon.

Claims 3, 5, and 6 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kang, et al.* (U.S. Patent No. 6,139,700), as applied to claim 1 above. Applicants submit that claims 3, 5, and 6 are patentable over *Kang, et al.* for the reasons discussed above with respect to claim 1. Applicants respectfully request withdrawal of the rejection of claims 3, 5, and 6.

Claims 7-9 stand rejected under § 103(a) as being unpatentable over by *Kang, et al.*, (U.S. Patent No. 6,139,700), as applied to claim 1 above, and further in view of *Kang, et al.* (U.S. Patent No. 6,287,965). Applicants respectfully traverse the rejection.

As discussed above, Applicants submit that *Kang, et al.*, (U.S. Patent No. 6,139,700) does not provide all of the limitations of claim 1, as *Kang, et al.*, (U.S. Patent No. 6,139,700) does not teach or suggest forming a bulk deposition layer on a nucleation layer by employing vapor deposition to deposit a refractory metal contained in one of first and second reactive gases used to deposit the nucleation layer. Applicants further submit that *Kang, et al.* (U.S. Patent No. 6,287,965) does not teach or suggest forming a bulk deposition layer on a nucleation layer by employing vapor deposition to deposit a refractory metal contained in one of first and second reactive gases used to deposit the nucleation layer. The Examiner states that *Kang, et al.* (U.S. Patent No. 6,287,965) teaches forming an ALD WBN layer followed by a W lower electrode layer (column 8, lines 1+). Applicants submit that *Kang, et al.* (U.S. Patent No. 6,287,965) describes a barrier metal layer 214 containing atomic layers of A (Ti, Ta, W, Zr, Hg, Mo, or Nb), B (Al, Si, or B) and N (nitrogen) (column 8, lines 17-23). The only specific metal layer that *Kang, et al.* describes is a TiAlN layer. *Kang, et al.* (U.S. Patent No. 6,287,965) describes forming a lower electrode 216 composed of a metal such as Cu, Al or W on the barrier metal layer 214 (column 9, lines 5-7, Figure 7D). *Kang, et al.* (U.S. Patent No. 6,287,965) does not describe how the lower electrode 216 is formed or indicate that the lower electrode 216 is a bulk deposition layer. Therefore, Applicants submit that *Kang, et al.* (U.S. Patent No. 6,287,965) does not provide all of the limitations of claim 1 as *Kang, et al.* (U.S. Patent No. 6,287,965) does not teach or suggest forming a bulk deposition layer on a nucleation layer by employing vapor deposition to deposit a refractory metal contained in one of first and second reactive gases used to deposit the nucleation layer. Thus, *Kang, et al.*, (U.S. Patent No. 6,139,700) in view of *Kang, et al.* (U.S. Patent No. 6,287,965) does not provide all of the limitations of claims 7-9, which depend from claim 1. Applicants respectfully request withdrawal of the rejection of claims 7-9.

Claim 14 stands rejected under § 103(a) as being unpatentable over *Kang, et al.* (U.S. Patent No. 6,139,700), as applied to claim 10 above. Applicants submit that claim

14 is patentable over *Kang, et al.* (U.S. Patent No. 6,139,700) for the reasons discussed above with respect to claim 10. Applicants respectfully request withdrawal of the rejection of claim 14.

Claims 1-14 stand rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-60 of *Kori, et al.* (U.S. Patent No. 6,551,929). Applicants are submitting a terminal disclaimer in a separate paper. Applicants respectfully request withdrawal of the obviousness-type double patenting rejection.

Applicants submit that new claims 15-33 are patentable over *Kang, et al.*, (U.S. Patent No. 6,139,700) and *Kang, et al.* (U.S. Patent No. 6,287,965), individually or in combination, for the reasons discussed above with respect to claim 1. Applicants respectfully request allowance of new claims 15-33.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the invention as claimed.

The secondary references made of record are noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, Applicants believe that a detailed discussion of the secondary references is not necessary for a full and complete response to this office action.

Having addressed all issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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